CLAIMS

What is claimed is:

1. A method, comprising:

- providing a bumpless die, a die carrier having a plurality of solder bumps thereon, and a heat spreader lid;
- bonding the die to the heat spreader lid to form a module; and
- bonding the module to the die carrier.

2. The method according to claim 1, further comprising thinning a bumpless wafer prior to the providing of the die and wherein the providing of the die includes separating the die from the wafer.

3. The method according to claim 2, wherein the thinning of the wafer includes thinning the wafer to have a thickness no greater than 50 microns.

4. The method according to claim 1, wherein the bonding of the module to the die carrier includes bonding the heat spreader lid to the die carrier with a sealant.

5. The method according to claim 4, wherein the providing of the die includes providing the die with a plurality of bond pads.

6. The method according to claim 5, wherein the bonding of the module to the die carrier further includes bonding the plurality of solder bumps on the die carrier to the plurality of bonding pads on the die.

7. The method according to claim 6, further comprising forming the plurality of bonding pads on the wafer using a dual Damascene copper plating process prior to the thinning of the wafer.

8. The method according to claim 6, wherein the bonding of the module to the die carrier includes forming a gap between the die and the die carrier containing only the plurality of solder bumps.

9. The method according to claim 6, wherein the bonding of the module to the die carrier includes forming a gap between the die and the die carrier containing the plurality of solder bumps and an underfill.

10. The method according to claim 6, wherein the solder bumps have a height of approximately 10 to 50 microns.

11. The method according to claim 6, wherein the bonding of the plurality of solder bumps to the plurality of bonding pads includes aligning each of the solder bumps with one of the bond pads.

12. The method according to claim 1, wherein the bonding of the die to the heat spreader lid includes forming a metallic bond by using a hard solder between the die and the heat spreader lid.

13. The method according to claim 12, wherein the forming of a metallic bond includes forming the metallic bond with a thickness no greater than 20 microns.

14. The method according to claim 1, wherein the providing of the die includes providing the die with an effective coefficient of thermal expansion in the range of 15 ppm/C to 16 ppm/C.

15. An apparatus, comprising:

- a bumpless die having a substantially planar surface with a plurality of embedded bonding pads;
- a heat spreader lid having the bumpless die mounted thereto to form a module;
- a die carrier having a plurality of solder bumps attached thereto; and

- the module being mounted to die carrier with the solder bumps being bonded to the bonding pads when the module is mounted to the die carrier.

16. The apparatus of claim 15, wherein the die has a thickness no greater than 50 microns.

17. The apparatus of claim 16, wherein the bonding pads are dual-Damascene-formed copper bonding pads.

18. The apparatus of claim 17, further including:

- a thermal interface material in the form of a hard solder interposed between the die and the heat spreader lid to bond the die to the heat spreader lid.

19. The apparatus of claim 18, wherein the thermal interface material has a thickness no greater than 20 microns.

20. The apparatus according to claim 17, wherein the plurality of solder bumps forms a gap between the die and the die carrier, with the gap containing only the plurality of solder balls and empty space.

21. The apparatus according to claim 17, wherein the plurality of solder bumps forms a gap between the die and the die carrier, with the gap containing only the plurality of solder balls and an underfill.

22. The apparatus according to claim 17, wherein the solder bumps and the gap have a height of approximately 10 to 50 microns.

23. The apparatus according to claim 15, wherein the die may have an effective coefficient of thermal expansion in the range of 15 ppm/C to 16 ppm/C.

24. A system, comprising:

- an integrated circuit (IC) package including a bumpless die having a substantially planar surface with a plurality of embedded bonding pads; a heat spreader lid having the bumpless die mounted thereto to form a module; a die carrier having a plurality of solder bumps attached thereto; and the module being mounted to die carrier with the solder bumps being bonded to the bonding pads when the module is mounted to the die carrier; and

- a circuit board having mounted thereon the IC package; a dynamic random access memory coupled to the IC package; and an input/output interface coupled to the IC package.

25. The system according to claim 24, wherein the IC die is a microprocessor and the circuit board is a motherboard.

26. The system according to claim 25, wherein the input/output interface comprises a networking interface.

27. The system according to claim 26, wherein the system is a selected one of a set-top box, an entertainment unit and a DVD player.

28. The system according to claim 24, wherein the die has a thickness no greater than 50 microns.

29. The system according to claim 28, wherein the bonding pads are dual-Damascene-formed copper pads.

30. The system according to claim 29, further including:

- a thermal interface material in the form of a hard solder interposed between the die and the heat spreader lid.